Assessing exposure and health effects for nanomaterial workers: Epidemiologic and biomarker approaches

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Increasing and coalescing evidence from animal studies of some engineered nanomaterials

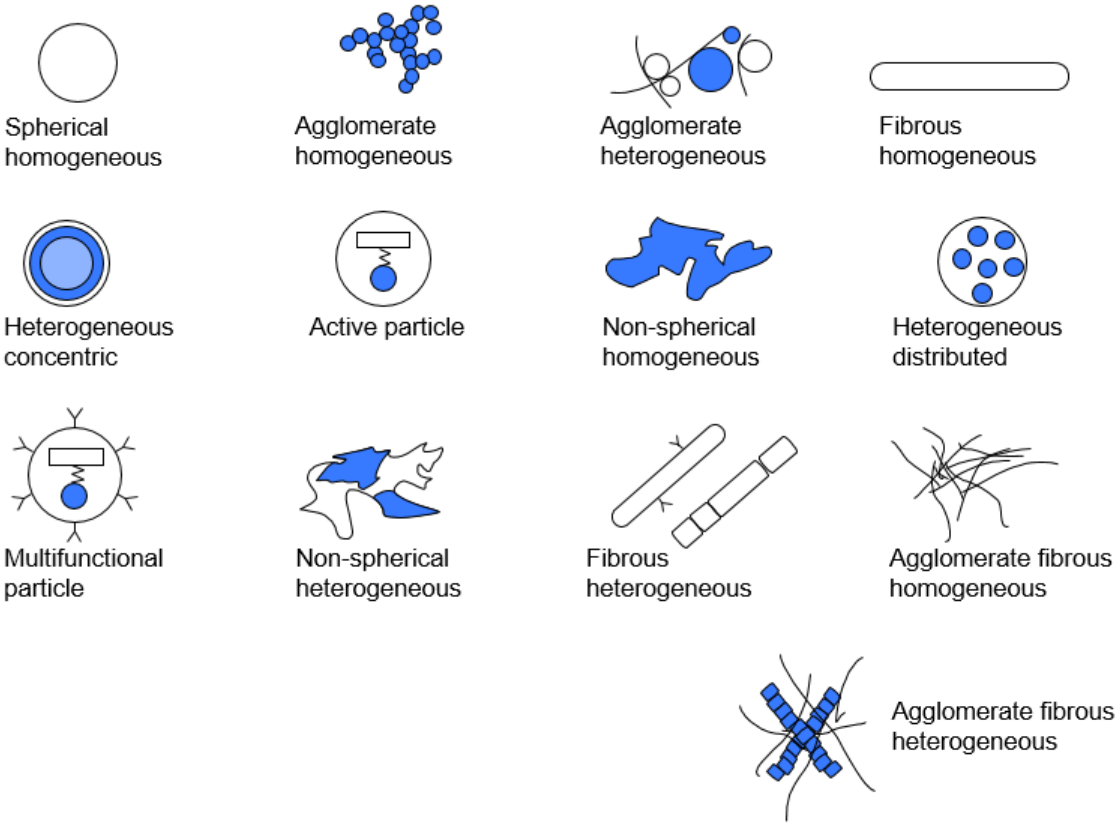
- Studies of experimental animals show cancer, pulmonary fibrosis, cardiovascular effects
- Consistent patterns of toxic effects related to oxidative stress
- Variability due to contaminants and physico-chemical parameters
- Effects seen after relatively short exposure and low doses

Epidemiologic issues

- Not intrinsically different from studies in other industries
- Inherent characteristics of nanoparticles and contemporary workplaces present difficulty
- Uncertainties in hazards and disease endpoints

Critical issues

- **Heterogeneity of nanoparticles**
- Identification of study population
- Temporal factors
- Exposure characterization
- Disease endpoints
- Design and analysis



Schulte, et al., 2009

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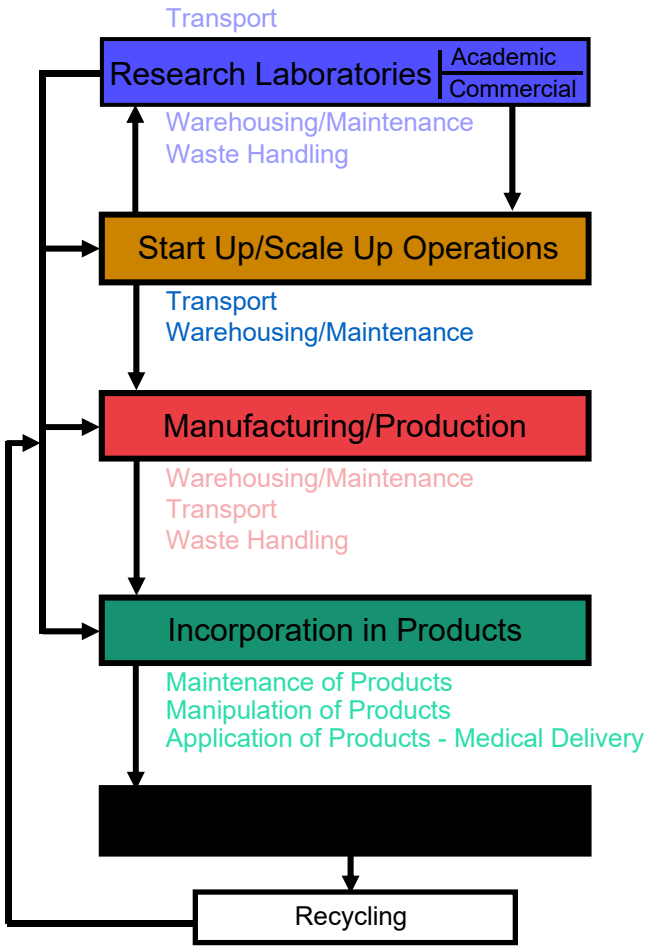
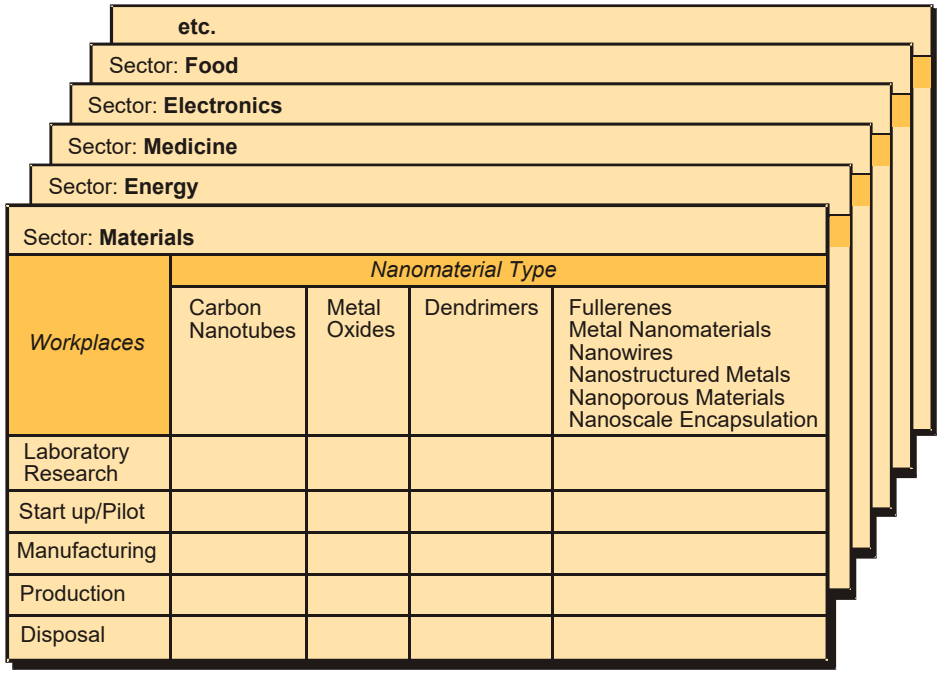

Transport
Research Laboratories
Academic
Commercial
Warehousing/Maintenance
Waste Handling
Start Up/Scale Up Operations
Transport
Warehousing/Maintenance
Manufacturing/Production
Warehousing/Maintenance
Transport
Waste Handling
Incorporation in Products
Maintenance of Products
Manipulation of Products
Application of Products - Medical Delivery
Recycling


etc.
Sector: Food
Sector: Electronics
Sector: Medicine
Sector: Energy
Sector: Materials
Workplaces
Nanomaterial Type
Carbon Nanotubes
Metal Oxides
Dendrimers
Fullerenes
Metal Nanomaterials
Nanowires
Nanostructured Metals
Nanoporous Materials
Nanoscale Encapsulation
Laboratory Research
Start up/Pilot
Manufacturing
Production
Disposal

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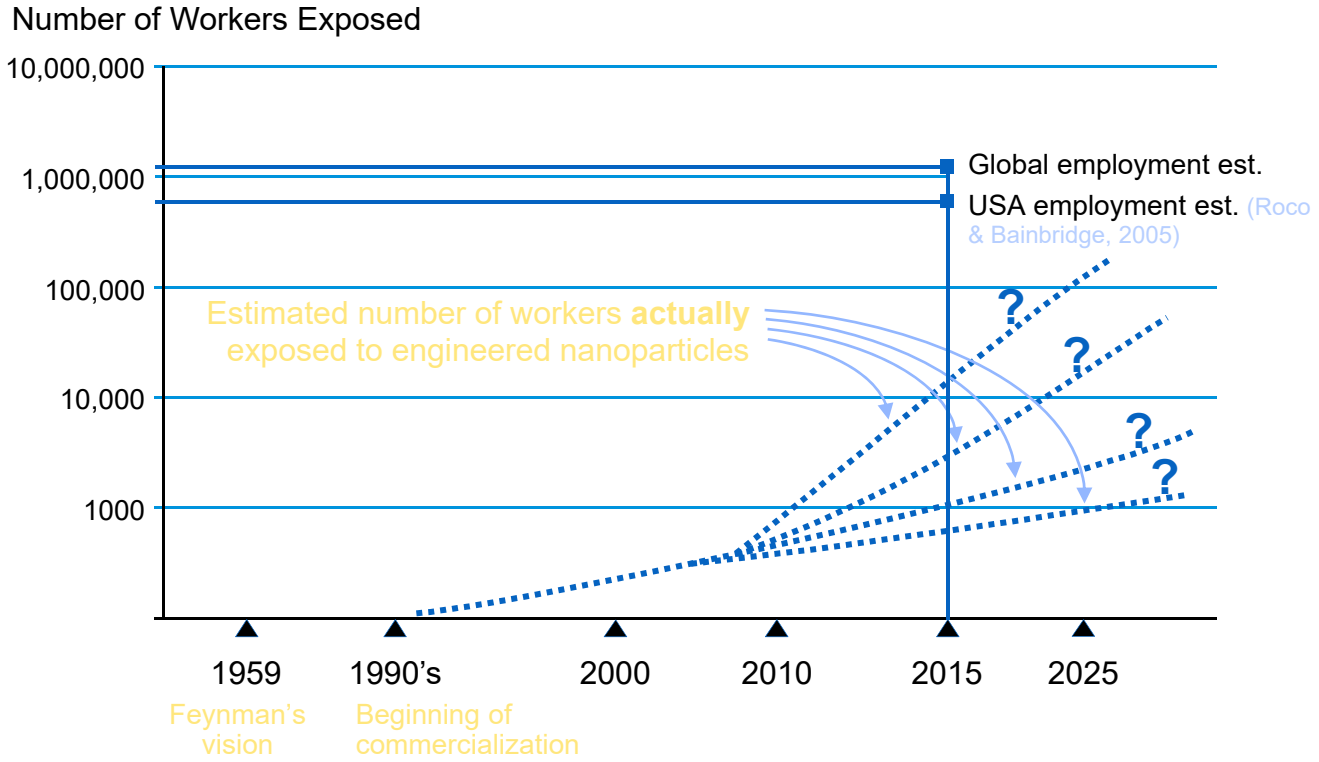
Dilemmas in identifying workers exposed to engineered nanoparticles



Schulte, 2009

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Exposure characterization

- Metrics
- Sufficiency of exposure
- Differential exposure
- Levels by jobs and process

Disease endpoints

- Acute
- Chronic
- Distinguish from effects of air pollution and other industrial exposures

Design issues

- Sample size
- Retrospective vs. cross-sectional vs. prospective
- Biomarkers

Exposure registry

A *system* for collecting and maintaining in a structured *record,* information on persons with *known or suspected* occupational or environmental exposure to a *hazardous* substance.

Exposure registry (cont.)

- Used in public health for over 50 years
- May serve as a societal response to hazardous exposures
- May serve as preparatory step for epidemiological studies
- May allow for risk communication

Questions about exposure registries

- Who would fund/manage them?
- What data would be collected?
- Who would have access to the data?
- Could any investigator with a research proposal have access to the registry?
- Are there non-research implications and responsibilities for those who manage registries?
- Are there expectations for those who participate in them?

Model for a Nanomaterials Worker Health Study